

# Global and Local Hypermedia Design in the Encyclopaedia Africana

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## **Abstract**

The tradition of presenting information on the printed page assumes a single location for each piece of information within a collection and an implicit linear order. It also limits the information to what can be presented with ink on paper, excluding audio, video, and animated graphics. Hypermedia technology offers new possibilities of content and organization to the author and navigation to the reader. With these new possibilities come new design challenges. The designer must create a structure flexible enough to express the fluid nature of hypermedia, while still clear enough to guide the reader's navigation. This is best accomplished by understanding the need for global and local design structures in hypermedia publications. We explain this in terms of our design for a prototype electronic encyclopedia of African and African-American culture, the *Encyclopaedia Africana*.

## **The Visual Appearance of Hyperspace**

Much of the design literature about hypermedia has focused on the underlying software model and proposed data interchange standards for supporting this innovative technology, i.e., Dexter Model [Halasz 94], HDM [Garzotto 93], HyTime [Newcomb 91], etc. While this is an important concern, our experience has shown that there are equally important presentation design issues that must be articulated and addressed. The presentation layer is often found at the bottom of the design hierarchy in these models and is the last to be considered. However, it is at the presentation layer that the information in the underlying software model actually finds its way from abstract machine space into the user's perception.

Hypermedia design must appeal to a combination of previous cognitive and interaction experiences to be understood. This appeal to previous experience need not aspire to reproducing 3D models of the mechanical world. We lose the reader when we give her less visual information than she expects from previous experience. We must first identify the best "previous experience" to appeal to.

We understand how to operate an unfamiliar automobile by appealing to our previous driving experience. We learn to expect specific motion as the consequence of turning the steering wheel and we expect certain spatial relationships between the accelerator and the brake pedals. We also expect a limited range of relationships between the pressure we place on the accelerator pedal and the forward motion of the vehicle. We then might learn how to fly a plane by seeing it as three-dimensional automobile driving. However, the experienced automobile driver, who understands how to control a limited set of motions and relies on highway signs, will suffer from cognitive overload when first placed in the pilot's seat. Eventually she will learn to sense and control pitch, yaw, climb, and descent, and learn to navigate by relying on charts and instrumentation augmented by verbal commands, as well as a set of signs on the ground, by mentally mapping the interaction between these elements. By analogy, the designer of hypermedia must appeal to the experience of the reader of books, the viewer of television, the listener to recordings, and the user of computer programs to provide orientation and direction.

The defining feature of flying is the ability to move through the air in three-dimensional space. The defining feature of hypermedia is the ability to traverse a link, a navigational connection between two information elements. However, the hypermedia collection is no more a simple collection of links than it is a

simple collection of words or images. For the reader to understand what is being communicated, the words, images, and the links must be organized into larger structures.

We can best understand how to operate hypermedia by appealing to the visual tradition of publication design. The designer of hypermedia can also appeal to the experience of viewing television, listening to recordings, and using computer programs to provide orientation and direction. It is publication design, however, that offers us the richest tradition of visual communication in the two-dimensional space where most of our interactions with the computer take place.

### **Global and Local Structures**

All publications require visually distinct global structures and hypermedia is no exception to this rule. By global structure I mean a visual expression of how groupings of information in the collection make up the collection as a whole. This is the equivalent in visual design to the need for global coherence discussed by Thüring et al.

Such design must shape an orderly foundation on which to represent the author's axes of connections, the information hyperspace. Orderly in this sense means appealing to a pattern that can be sensed by the reader, as stated by Rudolf Arnheim: "Order is a necessary condition for anything the human mind is to understand. Arrangement such as the layout of a city or building, a set of tools, a display of merchandise, the verbal expression of facts or ideas, or a painting or a piece of music are called orderly when an observer or listener can grasp their overall structure and ramification of the structure in some detail." Anyone who has found himself lost in a building with curved hallways, unable to find an item in a crowded shelf display, or befuddled by the color coding on a line graph has felt the absence of "orderly" visual design. Indeed Passini's recent *Wayfinding In Architecture*, while addressing architectural issues, speaks to the general topic of orientation in real and virtual space. This need for orientation is as relevant to hypermedia publications as it is to city planning. The reader of a publication enters a man-made environment where he or she is accustomed to using several forms of visual order to support global navigation.

The physical appearance of the printed publication itself expresses the quantity of its content. The reader gets a sense of the physical weight and texture of the content from the paper, binding, and cover materials used to contain it. The table of contents orients the reader to the scope of the publication as the author intends it to be viewed. The topic index provides another method for understanding the scope of the publication that is less dominated by the author's intentions. The regions at the top (header) and bottom (footer) of the page, containing some combination of title, subtitle, and page number, are used to remind the reader of the location within the publication. On specific pages cross-references, which point to related information within a publication, and notes, add a secondary layer of explanation or point to related information outside a publication. These local references build on the global structures already in place.

It is extremely difficult to convey the quantity of a hypermedia publication. The physical appearance of a hypermedia publication, does not convey an accurate sense of quantity, whether it is a set of diskettes, a CD ROM, or a

phone call through a modem. All these formats contradict the reader's previous experience with print publications. The fact that a multimedia encyclopedia can fit onto a single compact disc what in printed form fills dozens of volumes is a marvel of contemporary engineering, but it is essentially disorienting. The same physical media can contain much less information than a typical printed book, so the reader simply does not know what to expect. The reader cannot tell if he or she is viewing the tip of the iceberg or the iceberg itself without additional visual cues in presentation design.

Providing clear visual expression to scope and location are difficult problems. The designer of a print publication must choose a single order and a single location for each story and picture, even though their content may be usefully juxtaposed in many places throughout a publication. One of the major innovations of hypermedia is its capacity for supporting multiple views and multiple access points. This produces publications with many rather than a single scope, potentially multiple tables of contents. The very notion of location is undermined by the lack of a single linear structure. At the same time the visual space where scope and location information has been presented, the header and footer area in page layout, is reduced by the limits of screen size and resolution, or user interface considerations such as resizable and overlapping windows and scrolling text fields.

Hypermedia collections also contain navigation structures which are local to specific elements. These local structures have a clear analogy in publication design. As mentioned above, cross-references and notes are common examples of local links, as are glossaries. The functional distinction between global and local links is important for reader orientation. Global links take the reader between structural parts of a publication or collection. Local links, by contrast, are connections that are specific to the content of an individual unit of information.

The visual representation of link presence is an important design consideration for local link navigation. The hypermedia system must support the designer's efforts to accomplish three things that are often at odds with one another: distinguish linked from unlinked text, preserve legibility of linked text, and mark the extent of the link anchor. In systems which support multiple types of links, either by category, behavior, or both, some indication of type supports orientation [several design issues concerning the marking of links in text are discussed in Kahn 95]. A new combination of visual methods used in the Encyclopaedia Africana prototype is described below.

### **Encyclopaedia Africana Prototype**

In August 1994, an editorial team at Harvard University's W.E.B. Du Bois Institute for Afro-American Research engaged my information design company, Dynamic Diagrams, to develop a prototype for the Encyclopaedia Africana (EA). The EA is expected to be a large electronic database to be developed over the next decade. The content will be a comprehensive and authoritative compilation of systematic knowledge about Africa and the African diaspora, intended for students, researchers, and the general public. The editorial team provided the text of representative articles, associated image, video, and audio materials, and the information for developing related timelines and maps. The prototype [1], completed in December 1994, was built as a proof-of-concept to promote and guide the later development effort.

The design goals included developing an interface that could be created using current technology, while at the same time suggesting what could be done tomorrow. With this in mind, we took liberties with screen size and color depth, as well as using some hardware support to improve the quality of digital video. At the same time, we based our design on well-established practice found in today's user interface vocabulary: command buttons, drop-down menus, and pop-up windows.

A prototype is not a final product, and the work described here is not a true electronic encyclopedia. It has not and cannot be reviewed for usability in the same way commercial multimedia encyclopedias such as Comptons, Grolier or Encarta have been evaluated [Banet 95]. However, the finished prototype is an example of well planned and executed hypermedia design. It embodies many of the principles of hypermedia design which I have learned from collaborating with hypermedia and graphic design practitioners including George Landow and Krzysztof Lenk (see the Acknowledgments section below for the names of the people involved in the design and production of the EA prototype). Therefore I offer a portion of the design as an exemplar of what global and local hypermedia design should accomplish. The following discussion will focus the design for representing contents and stories. A discussion of the treatment of timelines and animated maps is set aside for another paper.

### Global Structure and Controls

The opening screen of the EA presents the reader with the global structure of the complete encyclopedia as well as the global navigation controls that will be present throughout the application. Its main features are the introduction of the spatial division of the screen, the global controls, and the visualization of the content's structure.

#### *Spatial division*

The EA prototype was designed for a screen of a specific size (832 pixels by 624 pixels). This area was divided into a grid containing five large columns and a border area on the left and right. These border areas and a border area along the top edge were reserved for the display of control structures. They are the visual analogy of a curtain defining the "stage" on which text and other media elements will be presented. This division of space, introduced in the first screen, is intended to remain constant throughout the application, helping the user to learn the meaning of controls through positional grouping [Kahn 90].

#### *Global controls*

Global controls are found in the left border. All these controls lead the reader to content of the encyclopedia collection: stories, maps, and timelines. The first of these controls will return the reader to this main table of contents page at any time from any location. Stories can be accessed alphabetically by head word, as in any printed encyclopedia, by using the "Alpha" control. The underlying data structure of the encyclopedia also assigns one or many topic indexes to each story, and these can be browsed with the "Topic" control.

Much of the information in an encyclopedia has a geographic and/or chronological dimension. These can be visualized in the form of links to and from maps and timelines. Separate global controls were reserved for browsing lists of maps and timelines that are themselves interesting collections of information and connect multiple stories.

Other general controls are found on the lower portion of the left border. These include buttons for printing the current story, searching the database through text query, seeking help or tutorial instruction, and quitting the application.

### Visualization of the Contents

The task of visualizing the overall structure of the encyclopedia is the central purpose of the table of contents (figure 1A). This is defined by eight major topics or chapters, each represented by a title, and image, and an audio/video montage with a list of subtopics. The audio/visual summaries are an important part of the design, intended to express the many facets of African culture that cannot be captured in text. Browsing through these montages is intended to give the reader a sense of the range of topics and visual materials available in each division of the encyclopedia.

The reader may select a major topic to display its subtopics, and from a subtopic display a list of stories.

**Figure 1a**  
*Encyclopaedia Africana*  
 Table of Contents. Eight topics are listed, each with a representative image. The global controls appear on the left margin.



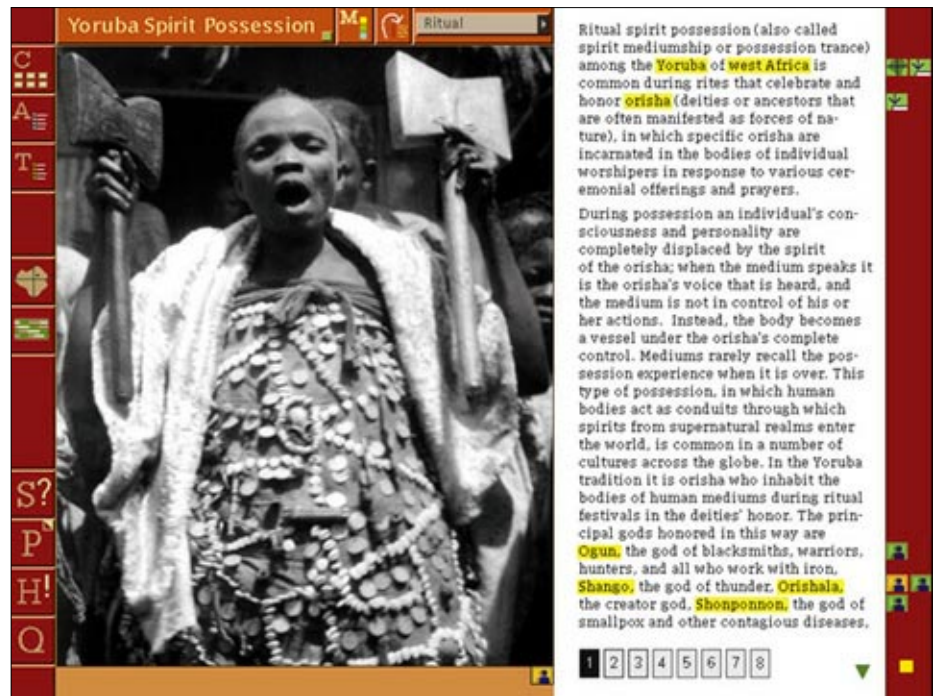
**Figure 1b**  
 Montage and subtopic preview of Art. Selecting the image for a topic launches a movie which previews material from the topic area, as well as listing the subtopics.





Figure 2

Screen 1 of 8 for Yoruba Spirit Possession story. Link anchors are marked with yellow highlight in the text of the story. The icon in the right margin indicates the type of information in the link destination. The image displayed on the media stage is a photograph of a priestess as the god Shango, indicated by the highlighted icon at the third line from the bottom.



The appearance of the yellow highlight also appeals to the reader's previous experience. It supports the analogy of a light-colored highlight marker, often used by readers to mark important sections on a printed page without obscuring their content. This analogy, which was suggested by one of the editors, is an appropriate one for the task at hand.

However, this method of marking link anchors still has the disadvantage of emphasizing the linked words and phrases above all other textual elements. Such visual emphasis may have little or nothing to do with the voice of the story itself. If the user's primary comprehension goal is to read the text of the story, such link markers in the text column would present a serious distraction. Therefore we added a toggle control to the lower right border area (a yellow diamond for on, a white square for off) to switch the link highlight on and off on each page. With this control the reader can turn the highlight on to scan for links and turn it off to maximize reading comprehension.

#### *Link explainers*

Following a link supports either of two link behaviors. Both are intended to be non-destructive to the user's visual context.

The first behavior is for the link destination to be displayed in the media stage, replacing any material that had occupied this area. This behavior is used for a link between a word or phrase in the story and a media element that can be presented on the media stage, such as an image, video, audio, or a small map. The icon for the selected element changes to the active color and the element is displayed on the media stage. Particular attention is paid to supporting local coherence through clear visual display of both the source and destination of a link [Thüring 95]. A caption for the media element is displayed below, or, if the media element is large enough, minimal space is reserved for an icon control that allows the user to display the caption over a portion of the text column. An editorial selection of an initial media element is made for the reader on each screen.

The second behavior is for a link between two stories. Such a link will necessitate the loss of local coherence by replacing the link source with a completely different link destination. In this case a link explainer is presented first, containing a sentence explaining the context of the linked destination. The reader is free to follow the link or dismiss the link explainer and defer navigation.

#### *Media stage and media browser*

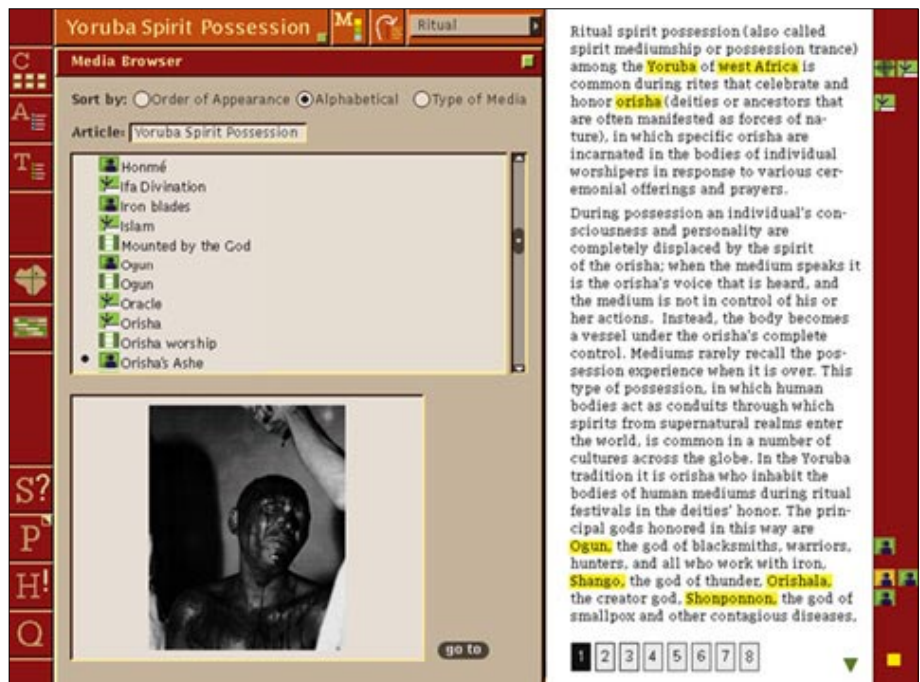
The EA is intended to be a large collection of multimedia information. While the core of the information is a set of text stories, the nature of the information it contains is best expressed with combinations of text, images, audio, and moving images. We wanted the design to emphasize the combination of textual information with other media and to support the user's viewing and access to all forms of digital media.

The reader is free to view the media elements associated with text by selecting the link icons on the right border of each screen. We also wanted to allow the reader to look at the media elements associated with each story in a more flexible manner. A media browser control in the top border of each story screen allows the reader to fill the media stage with a browser listing all the story's media elements (figure 3). These elements can be sorted in several orders. In each case the reader can select the element's title and preview an image or representative sound. From this preview the reader can navigate to the screen that contains the appropriate context, the caption and linked text anchor, for that media element.

#### *Story footer*

As mentioned above, quantity is difficult to convey in electronic publications. In the prototype there was little we could do to convey the magnitude of the proposed encyclopedia itself. However, it is imperative to convey the magnitude of each story in a clear fashion. To understand the information presented on each screen the reader should clearly see that he is viewing one of two or one of twenty parts of a story. The reader should also be able to move around within a story as easily as he can by flipping pages in a book.

Figure 3  
Screen 1: Media Browser for Yoruba Spirit Possession story



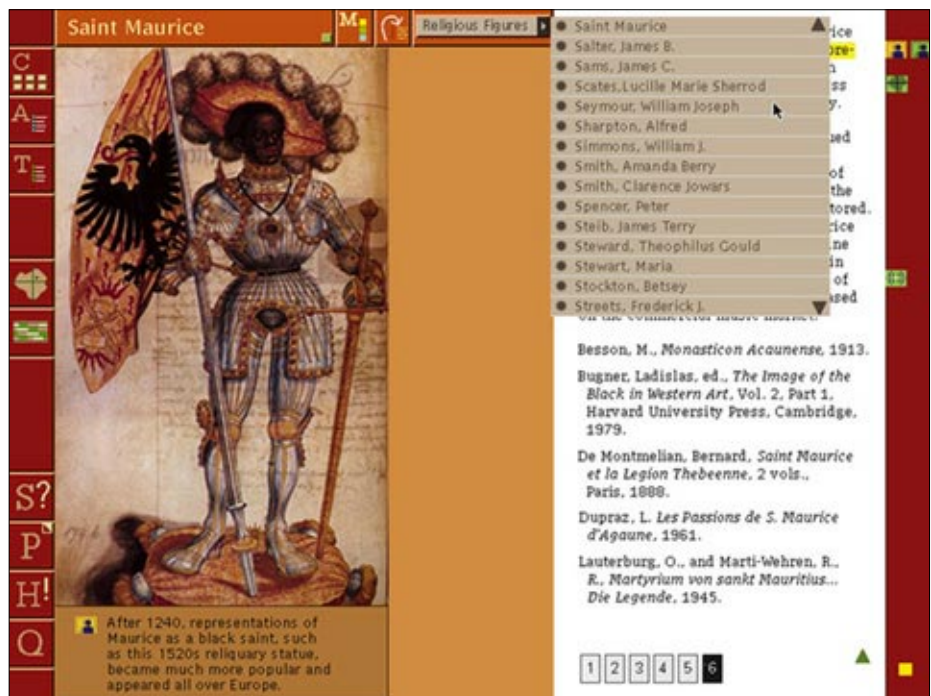
To quantify each story and support internal navigation, we reserved an area in the text column for page markers and next/previous buttons. The page markers convey the number of parts in each story, the current location in the story, and provide controls for moving quickly among specific parts. The next and previous controls allow the reader to move in a linear fashion through a story.

#### Story header

In addition to the control for the media browser, the story header in the upper border contains title information about the current story. It helps the reader locate where he is by providing a title or headword, access to basic information about the story's subject (such as birth and death dates, nationality, etc.), and the subtopic or topics under which the story is located. As the reader moves among the parts of the story, displaying various media elements, this information stays on the screen at all times.

The reader can also use the current subtopic as a navigation path to reach related stories (Figure 4). The relationship between the current story and the stories in the topic list is the intersection of topic indexing and alphabetical order. This form of navigation is closer to browsing the stacks in a library than hypertext. However, unlike a book on a shelf, a story in the EA can be located in several "virtual shelves" here represented as topic/subtopic lists. For example, the story on Saint Maurice, an early Christian military leader and Catholic saint from northern Africa, is indexed under both "Warfare/military leaders" and "Religion/religious figures." The reader may switch between these two contexts and the list of related stories will vary accordingly.

Figure 4  
Screen 6 of 6 for  
Saint Maurice story  
with topic browser for  
"Religious Figures" stories  
beginning with the letter S



### **Conclusion and Future Work**

Our work on the prototype for the Encyclopaedia Africana illustrates how attention to global and local structure can support effective hypermedia design. Because the EA is a prototype, developed in an extremely flexible application (Macromedia Director), we were able to embody many of the concepts we have developed from our work with both research and commercial hypermedia systems. The resulting design has encouraged all members of the design and editorial team to pursue these same principles into future products.

It is hoped that the complete Encyclopaedia Africana database can be developed during the coming decade. During that time information will be collected and captured in standard formats, such as SGML, with the intention of use and reuse in a series of electronic and print products. It is our hope that electronic products produced in the next few years will make use of all or part of this design.

### **Acknowledgments**

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## References

- Arnheim, Rudolf. *Entropy and Art: An Essay on Disorder and Order*, Berkeley:University of California Press, 1971.
- Banet, Bernard. "Encyclopedias on CD-ROM: The Market Advances," *Seybold Report on Desktop Publishing*, Vol 9, No. 6 (February 6, 1995): 3-16.
- Garzotto, Franca, Paolo Paolini, and Daniel Schwabe. "HDM—A Model Based Approach to Hypermedia Application Design," *ACM Transactions on Office Information Systems*, Vol. 11, No. 1, (Jan. 1993): 1-26.
- Halasz, Frank, and Mayer Schwartz. *The Dexter Hypertext Reference Model*. Communications of the ACM, Vol. 37, No. 2 (February 1994): 30-39.
- Kahn, Paul, Julie Launhardt, Krzysztof Lenk, Ronnie Peters. "Design of Hypermedia Publications: Issues and Solutions" in *Proceedings of the International Conference on Electronic Publishing, Document Manipulation, and Typography (EP90)* edited by Richard Furuta, Cambridge University Press, 1990, pp. 107-124.
- Kahn, Paul, and Krzysztof Lenk. "Screen Typography: Applying Lessons of Print to Computer Displays," *Seybold Report on Desktop Publishing*, Vol 7, No. 11 (July 5, 1993): 3-15.
- Kahn, Paul, Ronnie Peters, and George P. Landow. "Three Fundamental Elements of Visual Rhetoric in Hypertext" in *Designing User Interfaces for Hypermedia*, W. Schuler, J. Hannemann, N. Streitz, eds., Springer Verlag, 1995.
- Landow, George P. "Hypertext" *Hypertext*. Baltimore: Johns Hopkins University Press, 1994.
- Newcomb, Steve, N.A. Kipp, and V.T. Newcomb. *HyTime the Hypermedia/Time-based Document Structure Language*. Communications of the ACM, Vol. 34, No. 11 (November 1991): 67-83.
- Passini, Romedi. *Wayfinding In Architecture*. New York: Van Nostrand Reinhold, 1992.
- Thüring, Manfred, Jörg Hannemann, and Jörg M. Haake. "Designing for Comprehension: A Cognitive Approach to Hypermedia Development" *Communications of the ACM*, Vol. 38, No. 8 (August 1995): 57-73.